

Evaluation of the Kenyatta National Hospital diabetic retinopathy screening program 2015-2016

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ABSTRACT

Objective: This operational evaluation was conducted to determine the effect of having a screening fundus camera in the diabetes clinic on the demand for eye clinic diabetic retinopathy services at the Kenyatta National Hospital (KNH).

Methods: A before-after evaluation design was used. The reference point was installation of a screening retinal fundus camera in the KNH diabetes clinic in May 2016. The 'before' period was January to June 2015 and the 'after' period was June to November 2016. The one-year gap between the evaluation periods was used for program development and user training. The primary measure of outcome was a comparison of the mean numbers of patients seen and treated before and after starting the screening program. Data was obtained from the medical records on both the diabetes and eye clinics.

Results: The total number of diabetic patients screened in the two periods was 3011 (monthly mean=502, SD=44) and 2739 (monthly mean=457, SD=38) respectively. The total number referred to the eye clinic increased from 494 (monthly mean=82, SD=16) to 1065 (monthly mean=178, SD=30) while the total number of patients treated with lasers or intravitreal injections increased from 107 (monthly mean=18, SD=5) to 333 (monthly mean=56, SD=39).

Conclusions: Starting a diabetic retinopathy screening program using a fundus camera used based at the diabetes clinic doubled the number of patients referred for further evaluation at the eye clinic (2.2-fold increase) and tripled the number of diabetics who received treatment for diabetic retinopathy (3.1-fold increase).

Key words: Diabetes mellitus, Diabetic retinopathy, Screening, Fundus camera

INTRODUCTION

Globally, Non-Communicable Diseases (NCD) including diabetes, hypertension, cancers and heart disease are gradually becoming an epidemic and important cause of morbidity and mortality. In sub-Saharan Africa (SSA) mortality from NCD is rising while that from communicable diseases is falling¹. In the Nigeria national blindness and visual impairment survey, about half (48%) of patients found to have diabetes did not know they had the disease². In 2015 the Kenya stepwise survey estimated that 1.9% of the adult population aged 18-69 years (about 420,000 people) have raised blood sugar defined as plasma venous value ≥ 7.0 mmol/L or currently on medication for diabetes while 3.1% had impaired fasting glycaemia³. From the same study raised blood pressure (defined as having systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or on medication for raised blood pressure) was found in 23.8% of respondents. Twenty seven percent were either overweight or obese, and women more than men (38.5% vs 17.5%).

The most common type of diabetes is type 2, usually found in adults. After a number of years (usually 20), diabetes mellitus type 2 seems to cause diabetic retinopathy which in turn leads to loss of vision from bleeding, retinal scars and macular edema. Type 1 occurs in younger ages and causes diabetic retinopathy earlier and more frequently than type 2. There appears to be no primary prevention of diabetic retinopathy so far. Early detection and management is therefore important. Recent estimates from the East African region show that about one in every three diabetics has diabetic retinopathy; 35.9% (95% CI 29.7-42.6) in Kenya and 27.9% (95% CI 26.4-29.5) in Tanzania^{4,5}. This means that about 140,000 diabetics have diabetic retinopathy in Kenya. It is estimated that about 42,000 (10%) diabetics in Kenya have vision-threatening diabetic retinopathy. The most common causes of vision loss in diabetics are diabetic retinopathy, cataracts and glaucoma. One of the most difficult-to-detect causes of vision loss in Diabetics is Macula Edema (DME). The prevalence of clinically significant macula edema in a Kenyan study was reported to be 8.7% in newly diagnosed diabetics at Kenyatta National Hospital⁶. A health system

assessment for diabetes and diabetic retinopathy in 2016 showed that only 32.6% of people living with diabetes in Nairobi had ever had a retinal examination, and only 15.7% of them had the examination in the preceding 12 months yet the recommendation is an annual retinal examination⁷.

Diabetic retinopathy is thus an important public health problem. Its epidemiology is well understood in various parts of the world but in Kenya we have little information. However, planning for a large epidemiological study in conjunction with Kenya Medical Research Institute KEMRI-Wellcome Trust is at an advanced stage. The natural history of the disease is well known across the world and we have no reason so far to believe that the course of disease is different in our population save for the effect of late presentation with advanced disease.

Screening has been shown to be effective in detecting early diabetic eye disease⁸. Screening methods involve examination of the retina using indirect ophthalmoscopes or taking retinal fundus photographs of diabetics. Photographs may be reported on site or remotely via telemedicine by an eye specialist. There are softwares that can do an initial analysis and distinguish referable patients for further assessment. The pictures for referable patients can be seen by an expert retinal reviewer (usually retinal sub specialist) who would recommend referral. This model is not routinely used in Kenya. A telemedicine study in Kenya for diagnosis of glaucoma in diabetic patients in Murang'a demonstrated 77.5% positive predictive value⁹. This study utilized a solitary image analyzer housed at the Aga Khan University Hospital in Nairobi. National diabetic retinopathy screening guidelines in Kenya are in the process of development.

Effective treatment of diabetic retinopathy (includes laser photocoagulation, surgery and intravitreal injections of anti-Vascular Endothelial Growth Factor (antiVEGF) is available at the Kenyatta National Hospital (KNH). The National Health Insurance Fund (NHIF) pays for anti-VEGF treatment.

Before 2014, diabetics from the main diabetes clinic at KNH running on Fridays would be referred to the eye clinic for examination if they had visual concerns. In 2014 the Diabetic Retinopathy Network (DR Net) launched a public awareness of the effects of diabetic retinopathy at the London School of Hygiene and Tropical Medicine¹⁰. Three Kenyans attended the meeting; the head of Ophthalmic services unit at the Ministry of Health, one ophthalmologist with an interest in retina from the Department of Ophthalmology (MG) at the University of Nairobi (UON) and a nurse in charge of the KNH eye clinic. Afterwards, he undertook a full retina fellowship in India. In the meantime, another ophthalmologist (JM) from the same department was undertaking a retina fellowship training in Canada. In 2015, he returned to Kenya and was taken to Kitwe, Zambia to see a diabetic retinopathy screening program. The design of a potential screening program in Kenya started developing. A trial

fundus camera similar to the one in current use was installed and used from 1st September 2015 to 31st October 2015 to begin training the hospital staff and residents. The technician was provided by the supplier of the camera.

In May 2016, a non-mydratic retina camera (Canon CR-2AF, Japan) was installed at the diabetes medical clinic in KNH. This was a first in a Kenyan public hospital. In the same month, a diabetic retinopathy team was taken to Lusaka, Zambia for training in photo grading and camera maintenance. It consisted of a clinic technician and an ophthalmic clinical officer. When they returned an experienced technician from the University Hospitals Coventry and Warwickshire NHS Trust, a partner and collaborator linked to the University of Nairobi through the DR Net and ICO Links program visited Kenya to further train the team.

From Monday to Thursday diabetic patients are attended to in what is commonly called a mini-diabetes clinic run by clinical officers. Those that need endocrinology specialist attention are referred to a specialist diabetes clinic on Fridays. At each of these clinics all the patients are invited to have a retinal screening fundus photograph taken by a technician who grades them. Any patient with a normal fundus photograph is asked to return for screening in one year. Any with an abnormality in the retina is referred to the eye specialist. They are given appointments to be seen within a week of taking the photograph. At the retina clinic, a dilated stereoscopic fundus examination is performed. There are two retina clinics every week, one on Wednesday and the other on Fridays. The following illustration shows the two-level screening program design.

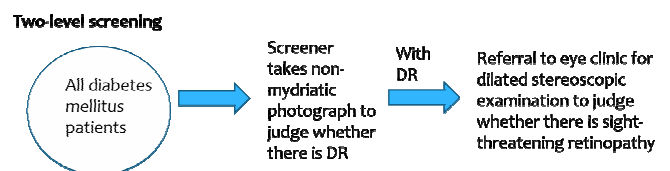


Figure 1: A model of the KNH diabetic retinopathy screening program

This operational evaluation was conducted to determine the effect of having a screening fundus camera in the diabetes clinic on the demand for eye clinic diabetic retinopathy services.

MATERIALS AND METHODS

A before-after evaluation model was adopted. Installation of the fundus camera in May 2016 was considered the beginning of the screening intervention. The 'before' period was considered January to June 2015. The 'after' period after was considered June to November 2016. Six month periods were considered adequate to review the

after period and short enough to avoid the seasonal effects and other background effects of the before period. There was a one year gap between both periods which was used for program development and user training.

The measure of outcome was to compare the mean numbers of patients seen and treated before and after starting the screening program. We analysed the mean number (and standard deviations) of patients screened in the diabetes clinic, referred to the eye clinic and the number treated for diabetic retinopathy with laser and/or anti-VEGF injections. We focused on these two treatment parameters without the number that had surgery (vitrectomy) as there are more barriers to surgery such as finance and logistics that may push patients to delay or seek care elsewhere. Data were obtained from medical registers in the diabetes and eye clinics, from the camera and from the registers for treatments offered in the eye clinic.

RESULTS

The overall effect comparing the before and after period are shown in Table 1.

Table 1: Summary of patients seen before and after camera screening

	Before (Jan-Jun 2015)	After (Jun-Nov 2016)	Change	% Change	Before: After ratio
Diabetic patients screened at the KNH daily mini diabetes clinic	3011	2739	-272	-9.0%	1:0.9
Diabetic patients referred to KNH eye clinic	494	1065	571	+115.6%	1:2.2
Diabetic patients treated with laser/injections at KNH Eye clinic	107	333	226	+211.2%	1:3.1

There was a 9% drop in the total number of patients screened in the daily mini diabetes clinic. In the six months before the intervention a total of 3011 patients was screened (monthly mean=502, SD=44) compared to a total of 2739 patients afterwards (monthly mean=457, SD=38). Despite this reduction, there was a 2-fold increase in the number of patients referred to the eye clinic from a total of 494 before to 1065 after (before: after ratio of 1:2.2) and a 3-fold increase in the number of diabetic patients receiving treatment with laser plus/ or anti-VEGF injections from a total of 107 before to 333

after (before:after ratio of 1:3.1).

Over the whole 2015-2016 period covered by the evaluation, the trends in services at the diabetes clinics and eye clinics were as shown in Figure 2. The trends in the diabetic retinopathy eye services on a month-by-month basis are shown in Figure 3.

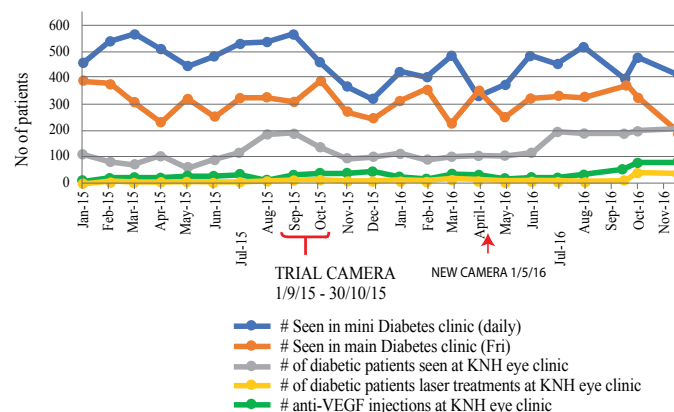


Figure 2: Summary statistics for diabetes and eye clinics over the evaluation period

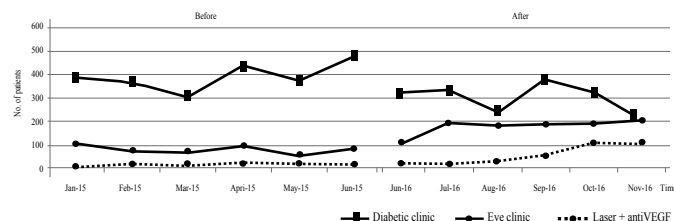


Figure 3: Month-by-month comparison of the before and after period for diabetic retinopathy services at the eye clinic

DISCUSSION

Implementation of a diabetic retinopathy screening program using a fundus camera placed in the diabetes clinic increased both the number of patients referred to the eye clinic and the number that received treatment for diabetic retinopathy. It is not clear why there was a 9% reduction in the number of patients seen at the diabetes clinic. In November 2016, there was a nationwide industrial action by health workers (doctors, clinical officers and nurses) which may have had an effect both at the hospital and health facilities lower down the referral system. This however may suggest that had the numbers in the diabetes clinic stayed the same or increased, there would have been an even greater increase in the diabetic retinopathy treatment service.

The increase in patients referred to the eye clinic to 178 patients per month with 2 retina clinics running every week translates to a case-load of 23 patients per retina clinic from diabetic retinopathy alone. The retina clinic attends to other retina problems apart from diabetic retinopathy. This increase has logistical implications on the quality of service offered at the retina clinic. If each patient needs to be dilated, a process that takes about

30-45 minutes, this would take a long time with the risk of hypoglycaemia if the patients are kept in the clinic for very long. The retina clinics are known to run from morning long into the afternoon. We now have two retina specialists and this may shorten the waiting time.

There were various weaknesses with this evaluation. Starting a new initiative such as a screening program is likely to change behaviour of health workers and patients with a higher level of awareness and emphasis on data recording after the intervention than was present before the introduction of the camera. This inherent shortcoming of before-after evaluations means the baseline (before) data is not always as accurate as the 'after' data. Secondly, the trends observed from 2015 to 2016 may include a seasonal element in the annual ebbs and flows of patients seen in the hospital that may not be fully attributable to the screening program. Also, every year around September a team from the diabetes clinic goes on outreach to different parts of the city which may lead to a sudden increase in the number of patients seen in both the diabetes and eye clinic.

Another important evaluation parameter is whether screening increases detection of vision-threatening diabetic retinopathy. This can be the subject of another study to be done by looking at individual medical records rather than patient registers such as the ones we used.

There were collateral benefits of the screening program. The residents had access to fundus photographs for discussion of cases in the weekly journal club held at the UON Department of Ophthalmology. Patients are now able to see 'the back of their eye' looks instead of only relying on the health worker's description.

Future developments in the program would need to include linking diabetes clinic and eye clinic data with the camera in one database. It would help to identify if we are losing any patients by tracking the number screened and not screened, the number referred to the eye clinic, and the number that attends or does not attend the eye clinic referral. Presently, there are no reminder systems for patients to enable compliance with follow up appointments. The use of short text messages (SMS) has been shown in various health settings to improve compliance with medication and attendance at health appointments¹¹. Further, the issuance of pre-paid referral vouchers at the diabetes medical clinic may improve the number that do attend the eye clinic referral. How to fund this can be discussed.

Various services may further augment the screening service. The gold standard for diagnosis of DME is Optical Coherent Tomography (OCT). It has a high sensitivity and specificity of about 80%^{12,13}. However, OCT is a very expensive technology in the developing world. In Kenya there are only 3 machines, all in private healthcare facilities in Nairobi. The teaching hospitals have none. A new OCT costs at least KSh 5 Million (US\$ 50,000) in Kenya. Vitrectomy surgery, laser, anti-VEGF (vascular endothelial growth factor) treatments

for diabetic retinopathy are costly and only available in various private facilities in Nairobi; Kenyatta National Hospital being the only public hospital offering this together with PCEA Kikuyu Eye Unit, a faith-based hospital just outside Nairobi. The University of Nairobi medical school has no equipment for vitreo-retinal surgery. Such equipment would consist of a vitrectomy machine to remove vitreous haemorrhages, laser machine to treat retinopathy, OCT to diagnose macula edema, and anti-VEGF injections for macula edema. Training of future generations of vitreo-retinal sub-specialists locally would become possible in such a unit.

CONCLUSIONS AND RECOMMENDATIONS

Introduction of a diabetic retinopathy screening program at KNH had a big impact. It increased the access to diabetic retinopathy services 2-fold from a mean of 82 patients referred per month (SD=16) to 178 patients per month (SD=30). The number of patients who received either laser or anti-VEGF injections tripled from a mean of 18 patients per month (SD=5) before to 56 patients per month (SD=39).

We recommend conducting baseline situation analysis for County-level hospital-based screening projects then replicate the pilot screening program in other County Referral Hospitals. A repeat evaluation of the KNH program one more year later would provide further information on sustainability. Nationally there is a need to institute mechanisms to manage the rise in case load in the eye clinics.

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